II. VERTEBRATE FOSSILS FROM THE FORT UNION BEDS.

By Earl Douglass.

In the autumn of 1901 the present writer made a small collection of fossil plants, mollusca, and vertebrates in the Fort Union beds at Bear Butte, in Sweetgrass County, Montana. The fossil plants were sent to Professor Frank H. Knowlton for identification, and the mammals were described by myself.[1]

Bear Butte is a mesa-shaped hill east of Widdecombe Creek on the John and William Widdecombe ranch ("Jack and Bill Ranch"), from sixteen to eighteen miles northeast of Melville, in the northern part of Sweetgrass County. A mile or more farther north Widdecombe Creek flows into Fish Creek. The butte is really a portion of the bench land or plateau, lying farther to the southwest, from which it is partly separated by erosion.

On the north and east sides of the northern portion of Bear Butte, the more nearly level surface which skirts its steeper portion is composed of dark clay-shales which disintegrate and weather into flaky particles. In places the wind and water carry away these particles, leaving small areas bare of vegetation. Below these shales are hard, thin-layered sandstones. These belong to division "E" of the "Laramie and Doubtful Laramie" described in another paper to be shortly published. Above these nearly pure shales, near the northern foot of Bear Butte, the shales contain ferruginous concretions, and there are thin lenses, bands, or layers of sandstone. The sandstones sometimes contain impressions of leaves, and in the limestones are fossil clams and bones and teeth of mammals and reptiles (crocodiles and champsosaurus). The shales which are known to be of Lower Tertiary age are, I think, not less than 100 feet in thickness. The thickness of this whole series of shales is probably more then 400 feet, and it may all be Tertiary. Within 10 or 15 feet of the top they contain impressions of plants. Just above the shales, at least on the western side of the

[1] "A Cretaceous and Lower Tertiary Section in South Central Montana," *Proc. Amer. Philos. Soc.*, Vol. XLI, No. 170, April, 1902.

northern portion of the butte, are quite hard sandstones, not many feet in thickness, which break off, and the slabs are found on the slopes below. These sandstones, which are overlaid by others more massive and probably grade laterally into them, contain many beautifully preserved fossil leaves. It is here that those which were identified by Knowlton were obtained.[2] Apparently the sandstones which cap the butte are in places laminated and in places massive at the same geological level; and in some places they are parted by beds of shale, while in other places there are thick masses without intervening shales. The massive sandstones contain some impressions of bark or stems of plants. There are fossil gasteropods in some portions of these beds.

A section of the bluffs south of Bear Butte, near where the road to Melville leaves Widdecombe Creek and ascends to the plateau, does not show any very massive sandstones, but they appear again in the face of the bluffs farther west. In the former locality the beds dip strongly to the southward, while at Bear Butte they are much more nearly horizontal. Following the road toward Melville, after ascending the bench, one passes for a long distance over a grassy prairie, but within three or four miles of Melville there are again outcrops of the Fort Union strata. The beds here are continuous with those which surround Bear Butte and are the same which the present writer examined in 1905.

Mr. A. C. Silberling has spent a considerable time in searching for fossil mammals in the vicinity of Bear Butte and Melville, and has obtained an interesting collection of remains, especially teeth, of early Eocene mammals. Only a small portion of these are the property of the Carnegie Museum. It is extremely interesting in the varied fauna which it suggests and the problems which it raises. It is of the greatest importance that collections be made from these beds accompanied by data as to the exact horizons from which the specimens come, as they may represent successive faunas instead of only one fauna. This is important in any collection, but especially so when the remains represent the earliest of the higher mammalian faunas which we know in this country.

The larger remains found here most nearly represent the Torrejon stage, but we have also a micro-fauna, part of which is different from

[2] See "Cretaceous and Lower Tertiary Section, etc.," *Proc. Amer. Philos. Soc.*, Vol. XLI, No. 170, pp. 217–218.

that of the Puerco and Torrejon of New Mexico. From Mr. Silberling's accounts and the data with the collections, it would appear that this micro-fauna is of the same age as the larger mammals in the collection (*Pantolambda*, *Euprotogonia*, etc.). From a chart and section which Mr. Silberling has kindly sent me, I judge that his collections are all from the same band — perhaps not more than 40 to 60 feet wide — from which the present writer obtained *Anisonchus*, *Euprotogonia*, *Mioclænus*, and *Pantolambda* in 1901. The principal source of these small mammals is a stratum of greenish sandstone, which Mr. Silberling found near Bear Butte. He quarried out some of this rock, broke it up, and found a considerable number of remains of mammals which have not been found elsewhere. Judging by the sketch and diagram which he sent to me, this layer is about 75 feet lower than the sandstones which form "the rim" of Bear Butte. This would be approximately in the same general horizon from which I obtained the specimens above mentioned.

The following list shows the fossils described in this paper, which, judging by the matrix, came from this quarry. Undoubtedly some of the other specimens came from the same place. Others came from the gray shales and from the layers or lenses containing *Unios*, which are 75 feet or more below the "rim rock."

Chirox ..... No. 1101.
Chirox ..... No. 1012.
Ptilodus montanus ..... No. 1673.
Ptilodus montanus ..... No. 1682.
Ptilodus montanus ..... No. 1684.
Cimolestes ? ..... No. 1013.
Picrodus silberlingi ..... No. 1670.
Coriphagus montanus ..... No. 1699.
Megopterna minuta ..... No. 1675.
Mixodectes ? ..... No. 1672.
Tricentes ? ..... No. 1677.
Tricentes ? ..... No. 1676.
Mioclænus ..... No. 1680.
Pantolambda ..... Silberling, Coll.

Order *ALLOTHERIA* Marsh.

Family BOLODONTIDÆ Osborn.

Chirox Cope.

(Proc. Am. Philos. Soc., XXI, 1884, p. 321.)

This genus is represented by three teeth : one tritubercular premolar

(No. 1012, Carn. Mus. Cat. Vert. Fos.), and two quadritubercular (No. 1685). They may all belong to one individual as they were found near together. The two quadritubercular teeth are apparently the corresponding premolars of opposite sides. Whether they are the third or fourth of the series is difficult to determine. Their antero-posterior diameter is nearly equal to that of the second premolar. According to Cope's figure[3] of *Chirox plicatus*, $P\frac{2}{2}$ and $P\frac{3}{3}$ are nearly equal in length while $P\frac{4}{4}$ is smaller. These teeth apparently represent a much smaller animal than the one described by Cope.

	mm.
Antero-posterior diameter of $P\frac{2}{2}$ (No. 1012)	3.
Transverse diameter of $P\frac{2}{2}$ (No. 1012)	2.6
Antero-posterior diameter of $P\frac{3}{3}$ (?) (No. 1685*A*)	3.3
Transverse diameter of $P\frac{3}{3}$ (?) (No. 1685*A*)	3.1

From beds of rather soft greenish sandstone (Silberling quarry) near Bear Butte, in the northern portion of Sweetgrass County in Montana. Collected by A. C. Silberling.

No. 1101 consists of four teeth, two at least of which belong to the genus *Chirox*. They are quadritubercular and are somewhat smaller than those just described. They are probably fourth premolars. A triangular pyramidal tooth may be a $P\frac{1}{1}$ or ante-premolar of *Chirox*. Collected by Silberling in 1903 from the Silberling quarry east of Bear Butte.

Family PLAGIAULACIDÆ Gill.

Ptilodus Cope.

(Am. Nat., XV, 1881, p. 921.)

In the collection there are quite a number of teeth of *Ptilodus* consisting of molars, premolars, and incisors. Probably two or three species are represented. The teeth are associated with remains of reptiles, and with eutherian mammals (*Pantolambda*, etc.).

Ptilodus montanus sp. nov.

(Type No. 1673, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type consists of a last lower premolar and a first lower molar inserted in a portion of the left ramus of a mandible.

Crown of $P_{\overline{4}}$ *semi-elliptical in a lateral view; crown not high, and upper portion of cutting-edge not extremely convex; eleven distinct and two posterior indistinct ridges on the crown;* $M_{\overline{1}}$ *nearly one half the*

[3] *American Naturalist*, Vol. XXI, June, 1887, p. 566.

length of $P\frac{4}{4}$, *with four external and six internal tubercles; anterior portion of tooth narrower than posterior portion.*

The last premolar is larger than that of *Ptilodus trouessartianus* Cope, but not so large as that of *P. mediævus* Cope. The longitudinal valley on the first molar is broadly V-shaped. There are two perpendicular ridges, separated by a median groove, on the inner surfaces of each of the outer tubercles. From Silberling quarry, east of Bear Butte.

	mm.
Length of $P\frac{4}{4}$	7.5
Length of $M\frac{1}{1}$	3.7

There are several fourth premolars in the Carnegie Museum collection (1682, 1683, etc.), and in the small collection loaned by Mr. Silberling, which evidently belong to this species, also a first molar (No. 1684). There are other smaller teeth which probably belong to a smaller species.

No. 1933 is an upper molar tooth. It is rectangular in shape, nearly square. Instead of having three rows of tubercles it has two rows and a continuous ridge on which is one rudimentary tubercle. There are four tubercles on the median and three on the outer row. The tubercles are neither quite conical nor crescent-shaped, but are intermediate between the two and are quadrangular at the bases.

Order *MARSUPIALIA?* Marsh.

Family CIMOLESTIDÆ? Marsh.

Batodon? Marsh.

(Am. Jour. Sc. (3), XLIII, 1892, p. 258.)

A lower molar (Carn. Mus. Cat. Vert. Foss., No. 1693) somewhat resembles the teeth figured by Marsh as *Batodon tenuis*, though there is much doubt that it belongs to that species. The specimen is somewhat larger than the figure and the trigonid is higher. The heel is low and has three low cusps, two lateral and one median, which bound the basin of the heel posteriorly.

	mm
Length of molar	3.
Height of trigonid	2.9

Another tooth (No. 1692, Plate I, Figs. 7–8) is of approximately the same size, but is shorter antero-posteriorly. The anterior portion is high and the two principal cusps equal in height. The posterior

face of the trigonid is nearly perpendicular. The anterior cusp is antero-posteriorly compressed and is oblique. It is somewhat cingulum-like in form. The heel is short antero-posteriorly and is composed of three distinct cusps.

	mm.
Length of molar	2.4
Height of trigonid of molar	3.4

A lower molar (No. 1691, Plate I, Figs. 1–2) probably belongs to the Cimolestidæ. The trigonid was composed of two prominent cusps and an anterior conule. One of the cusps is broken off at the base. The remaining cusp is high and curves backward toward the apex. The anterior conule is well defined. The heel is separated by a transverse valley from the trigonid and it has three small, low, blunt, nearly equal-sized tubercles.

	mm.
Length of molar	3.25

Cimolestes? Marsh.

(PLATE I, FIGURE 16.)

(Am. Jour. Sc. (3), XXXVIII, 1889, p. 89.)

The left ramus of a mandible (No. 1013), is referred provisionally to this genus. It has the alveoli of the molars and premolars, but no tooth, except a somewhat injured last molar. Ten comparatively large, transversely oval alveoli are shown anterior to $M_{\overline{3}}$. The alveolar border of the mandible is nearly straight and the anterior portion of the coronoid process ascends abruptly. The lower border of the jaw is somewhat convex. The heel of the last molar is low and has three low, blunt tubercles. Associated with *Ptilodus*, *Chirox*, crocodile teeth, etc. From Silberling quarry east of Bear Butte, Montana.

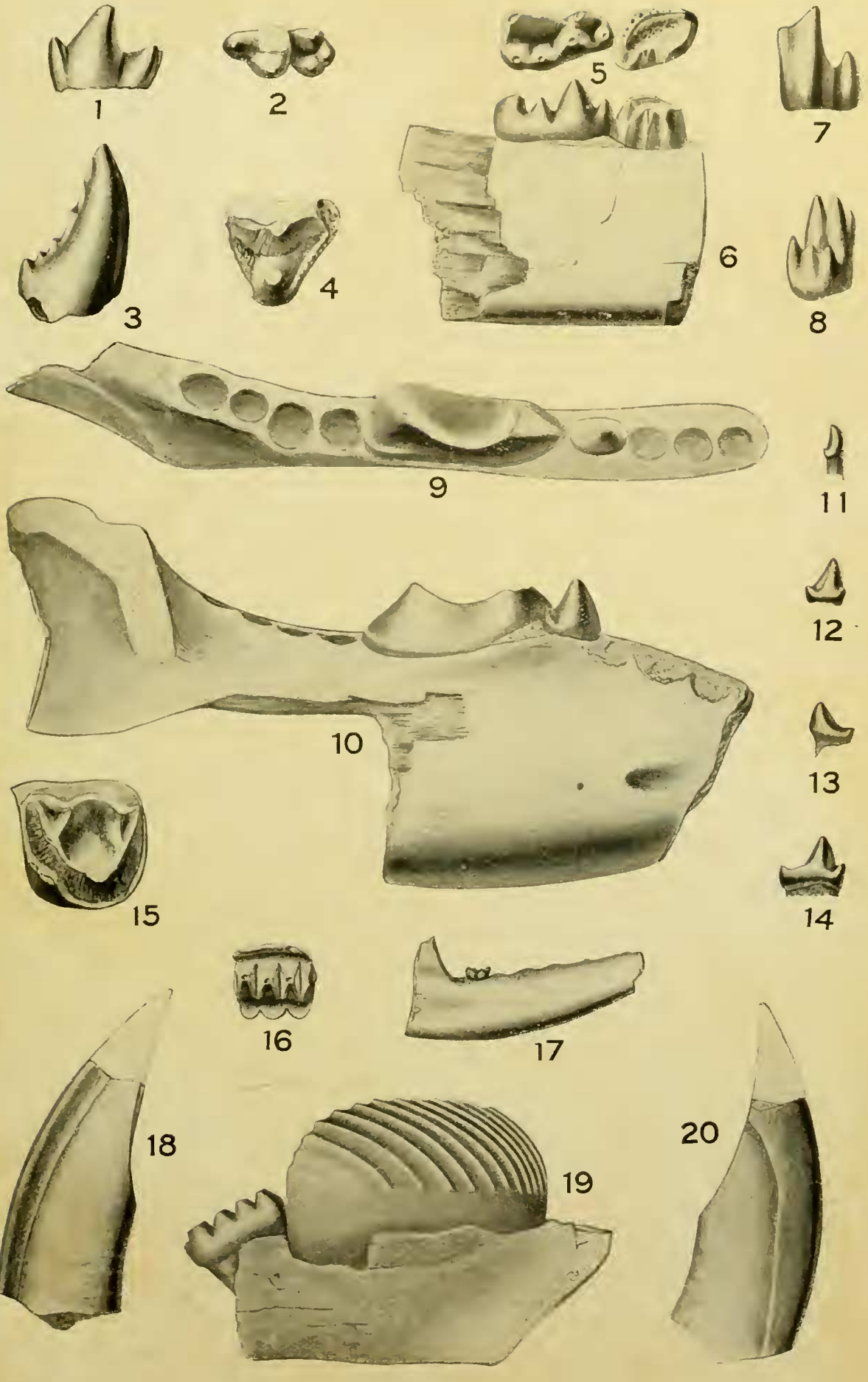
	mm.
Length of $M_{\overline{3}}$	2.9
Length of portion of mandible preserved	22.0
Depth of mandible under $M_{\overline{3}}$	5.4

Family DIDELPHYIDÆ Gray.

Peratherium? Aymard.

(Ann. Soc. Agr., Sci., Arts et Comm. du Puy, XIV, 1850, pp. 81, 83–84.)

Number 1001, Carnegie Museum Catalogue of Vertebrate Fossils, is a fragment of a mandible with one nearly perfect molar tooth, which considerably resembles the second lower molar of *Peratherium alternans*



Fort Union Mammals.

as figured in Cope's Tertiary Vertebrata, Pl. LXII, Fig. 23. The trigonid is high and has three small tubercles arising from the summit, the median being minute. The anterior face of the trigonid is transversely convex, the posterior face flat. The heel has a small, long, sharp-pointed posterior cusp and two short lateral lobes which are hardly well enough developed to be termed cusps. The heel is separated from the trigonid by a transverse valley.

Family EPANORTHIDÆ? Ameghino.

Picrodus silberlingi gen. et sp. nov.

(PLATE I, FIGURES 9–10.)

(Type No. 1670, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type consists of a portion of a mandible with two teeth.

Size small; mandible short and deep; the last premolar a simple, minute cusp with a small heel; molar a long, low tooth with the long, sharp cutting edge curved downward and outward in the middle. The first molar is about three times the length of the last premolar.

The teeth and jaw of this animal are peculiar. In certain of the characters of its dentition it suggests some of the Epanorthidæ which Ameghino has discovered in Patagonia. Though only two teeth are preserved, portions of seven alveoli can be seen in the mandible. Three of these are anterior to $P_{\frac{4}{4}}$ and are undoubtedly the alveoli of the first three premolars. Behind $M_{\frac{1}{1}}$ are four alveoli for two two-rooted molars. Apparently the premolars were all simple, conical, one-rooted teeth. The length of the anterior molar was greater than the combined lengths of the last two molars. The depth of the mandible under the first molar is about the same as the length of $P_{\frac{4}{4}}$ and $M_{\frac{1}{1}}$. From Silberling quarry east of Bear Butte, Montana.

	mm.
Length of portion of mandible preserved	10.
Length of $P_{\frac{4}{4}}$	1.2
Length of $M_{\frac{1}{1}}$	3.3

Order *INSECTIVORA?*

Coriphagus montanus gen. et sp. nov.

(PLATE II, FIGURES 3–4.)

(Type No. 1669, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type is the left portion of a mandible lacking the anterior part, the angle, and the upper portion of the ascending ramus, with the molars and the last three premolars in place.

Ramus of mandible moderately long and slender; masseteric fossa large and deep; teeth rather heavy and with low cusps; lower premolars 2, 3, and 4 two-rooted, cusps simple, oblong, lens-shaped in horizontal section, with one outer convex and two inner concave surfaces; molars with anterior trigon and a lower tuberculate heel, external cusps higher than internal cusps.

Nearly all of the teeth are somewhat worn. P and $P_{\overline{4}}$ are longer than $P_{\overline{2}}$. The outer faces of the premolars are very convex and are quite low-crowned. $M_{\overline{1}}$ has a heavy antero-external and a small antero-internal cusp. The anterior accessory cusp is minute. The heel is low but the external portion is highest. As seen from the outside, the latter is tuberculate. M has nearly the same form and size as $M_{\overline{1}}$ but $M_{\overline{3}}$ is smaller. I do not know of any species with which this can be closely compared. From Silberling quarry east of Bear Butte, Montana.

	mm.
Length of portion of mandible preserved	34.
Depth of mandible under $M_{\overline{2}}$	5.8
Length of last three premolars	8.
Length of molar series	8.7

Megopterna minuta gen. et sp. nov.

(PLATE I, FIGURES 5–6.)

(Type No. 1675, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type consists of a portion of a mandible with two teeth attached, probably a last lower premolar and a first lower molar. From the same locality as the types of *Picrodus silberlingi*, and *Coriphagus montanus*.

Size minute, mandible deep in proportion to the height of the teeth; $P_{\overline{4}}$ not showing distinct cusps, but with a raised inner border, the longest diameter being antero-internal and postero-external; $M_{\overline{1}}$ with three distinct anterior cusps, and a posterior basin-shaped heel much larger than the anterior trigon, which is bounded externally by two distinct tubercles and posteriorly and internally by a raised border.

The mandible is nearly as deep under $M_{\overline{1}}$ as the combined lengths of $P_{\overline{4}}$ and $M_{\overline{1}}$. The first premolar is so minute and the surfaces of the enamel reflect so much light, that it is difficult to figure its exact shape, yet the figure gives a very good idea of the form of the tooth. The outer surface of the tooth had perpendicular ridges and depressions. The top is nearly flat, but bounded postero-internally by a raised border.

The molar is quite peculiar. The anterior trigon is composed of three distinct cusps, of which the postero-external one is the larger and the anterior one the smaller. The heel of the tooth is much larger than the anterior portion. It is bounded externally by two tubercular cusps, while the posterior and internal borders form sharp ridges which meet at the postero-internal angle of the tooth forming a right angle. At this angle is a little thickening suggesting a rudimentary cusp. From Silberling quarry east of Bear Butte, Montana.

	mm.
Length of the two teeth preserved	2.7
Depth of mandible	2.7

Order *GLIRES?* (*RODENTIA*) Linnæus.

Family MIXODECTIDÆ? Cope.

Mixodectes? Cope.

(Am. Nat., XVII, 1883, p. 191.)

(PLATE II, FIGURES 9–10.)

One specimen (Carn. Mus. Cat. Vert. Fos., No. 1672) I am unable to assign with certainty to any genus that has been described, so I place it with much doubt in the genus *Mixodectes*. The specimen consists of two teeth in a portion of a mandible. They are so much worn that the exact original pattern of their crowns cannot be made out, but each had three cross-crests which were united on the outer portion of the tooth thus forming a figure something like a W, or an M. The large amount of wear indicates that the animal subsisted on hard substances, undoubtedly of a vegetable nature. From Silberling quarry east of Bear Butte, Montana.

Another lower molar (No. 1936) apparently belongs to the same genus. It is less worn and the anterior portion is higher than the posterior portion.

A portion of an incisor tooth (Plate I, Figs. 18 and 20) in the collection loaned by Mr. Silberling very strongly suggests that of a rodent. The tooth is broad antero-posteriorly and compressed laterally. The point is broken off. The tooth curves in the same manner as those of rodents. The anterior and posterior edges are rounded, making a cross-section of the tooth an oblong ellipse. The anterior face of the tooth is covered with enamel which overlaps one of the lateral surfaces more than the other.

Order *FERÆ* (*CARNIVORA*) Linnæus.

Family OXYCLÆNIDÆ Scott.

Protochriacus Scott.

(Proc. Acad. Nat. Sci. Phila., Nov. 15, 1892, p. 296.)

(PLATE II, FIGURE 15.)

There is a specimen (No. 1928), evidently a first upper molar, which I cannot distinguish from Matthew's figure[4] of the corresponding tooth of *Protochriacus hyattianus* (Cope) except that the present specimen is larger and has a continuous cingulum on the inner face.

Chiriacus? Cope.

(Proc. Acad. Nat. Sci. Phila., May, 1883, p. 80.)

(No. 1681, Carnegie Museum Catalogue of Vertebrate Fossils.)

This is a first lower molar which is provisionally placed in this genus. The anterior portion of the tooth is composed of two nearly equal-sized cusps and a minute anterior conule. This portion is considerably higher than the heel. The external cusp of the heel is larger than the internal cusp. At the posterior internal angle of this cusp is the posterior conule which is minute and is continued downward in a cingulum on the posterior face of the postero-external cusp.

	mm.
Length of tooth	5.9
Height of anterior portion of crown	3.6
Width of posterior portion of tooth	3.8

Tricentes? Cope.

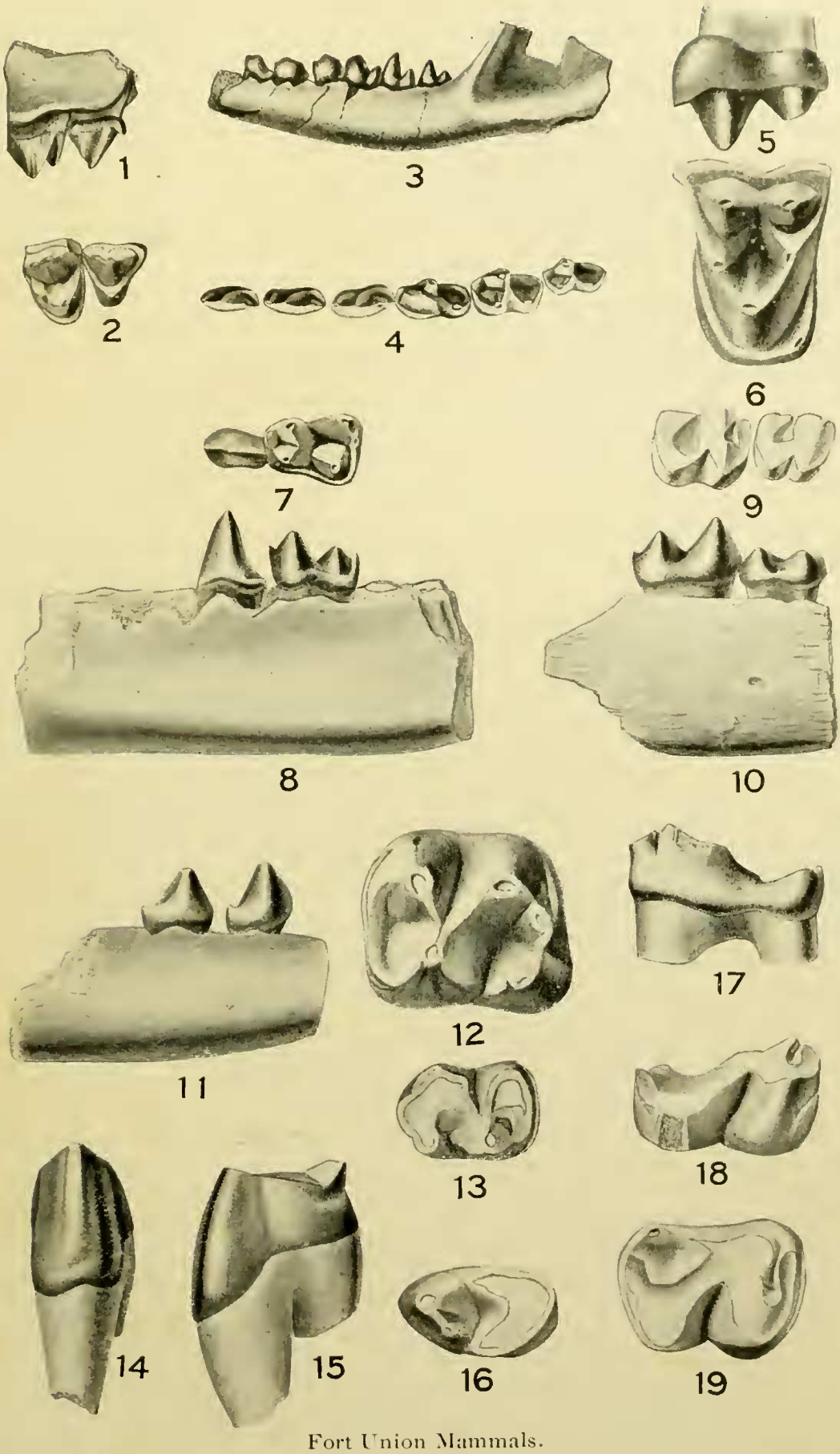
(Palæont. Bull., No. 37, 1883, p. 315.)

(PLATE II, FIGURES 5–8.)

An upper molar (No. 1676) and a portion of a mandible with the last premolar and first molar (No. 1677) are referred provisionally to this genus.

The upper molar exclusive of the cingulum is V-shaped. There are two principal external cusps, one internal cusp, and two smaller intermediate, nearly equal-sized conules. There are quite heavy external and internal cingula. The postero-internal portion of the cingulum is

[4] "A Revision of the Puerco Fauna," *Bull. Am. Mus. Nat. Hist.*, Vol. IX, Art. XXII, 1897, p. 269, Fig. 2.



Fort Union Mammals.

developed into a rudimentary cusp. From Silberling quarry east of Bear Butte, Montana.

The mandible (No. 1677) is quite heavy in proportion to the size of the teeth. $P_{\frac{4}{4}}$ is high, conical, and sharp-pointed. There is a rudiment of a heel. $M_{\frac{1}{1}}$ is oblong and the posterior is broader than the anterior portion. The two principal antero-lateral cusps are about equal in size, while the antero-median one is much smaller. The postero-lateral cusps are different in size and form. The external one is conical and bordered externally and posteriorly by a cingulum, while the internal cusp is continuous with the cingulum and is inwardly flattened. There is a rudiment of a cusp on the cingulum a little inward from the middle of the posterior border of the tooth. From Silberling quarry, east of Bear Butte, Montana.

	mm.
Length of premolar	4.2
Height of premolar	5.5
Length of molar	5.5
Width of molar	4.5
Height of molar	4.5

Deltatherium? Cope.

(Am. Nat., XV, 1881, p. 337.)

(PLATE II, FIGURES 1–2.)

(No. 1698, Carnegie Museum Catalogue of Vertebrate Fossils.)

This specimen consists of two upper premolars in a fragment of a jaw. The cusps of the teeth are quite high and sharp-pointed. A section of the anterior tooth is nearly an isosceles triangle, the base being external. The cusp is surrounded by a cingulum which, on the inner angle, forms a minute tubercle. The posterior tooth has a transversely narrower principal cusp, which is somewhat higher, and the inner cusp is comparatively large. There is a small rudimentary conule behind the latter. The tooth was surrounded by a cingulum. Each large external cusp has a small anterior rudimentary accessory cusp.

	mm.
Length of the two premolars	9.4
Length of the anterior premolar	5.2
Length of the posterior premolar	4.2
Width of the anterior premolar	4.9
Width of the posterior premolar	7.3

Order *BRUTA* (*EDENTATA*) Linnæus.

Family STYLINODONTIDÆ Marsh.

Calamadon? Cope.

(Rept. Vert. Fossils New Mexico, Extract from App. FF, Ann. Rept. Chief of Eng., 1874, p. 5.)

(PLATE II, FIGURES 14–16.)

(No. 1674, Carnegie Museum Catalogue of Vertebrate Fossils.)

It is very uncertain to what animal this tooth belongs. It is probable that it is the premolar of an animal related to *Calamadon* of the Wasatch beds. The tooth had one large and two small roots, one of the latter much larger than the other. These correspond with the three unequal-sized cusps of the crown. The tooth is oblong-suboval in section and probably the long axis of the oval was transverse to the axis of the jaw. The enamel extends downward much farther on the side of the largest cusp, which was probably the external portion of the tooth, than on the other side. The enamel is faintly ribbed, and there are broad vertical convexities, and minute pits, or short, transverse striations. The tooth is moderately high, but the cusps are very low, and the triturating surfaces of all are worn.

	mm.
Antero-posterior diameter of tooth	9.5
Transverse diameter	14.5
Height of crown, outer	13.
Height of crown, inner	7.5

Order *UNGULATA* Ray.

Family PHENACODONTIDÆ Cope.

Eutoprogonia Cope.

(Am. Nat., XXVII, 1895, p. 378.)

(PLATE I, FIGURE 4; PLATE II, FIGURES 12–13.)

There are several specimens in the collection which are referred to this genus, though I do not know of any teeth which exactly correspond to them in form. No. 1016 (Pl. I, Fig. 4) is apparently a fourth upper premolar, though it may be the third of the series. A horizontal section of the tooth is nearly an equilateral triangle. The angles are rounded. The outer pyramidal portion of the tooth is apparently composed of two united cusps, one higher and larger than the other. The partial separation of the outer cusp is a condition inter-